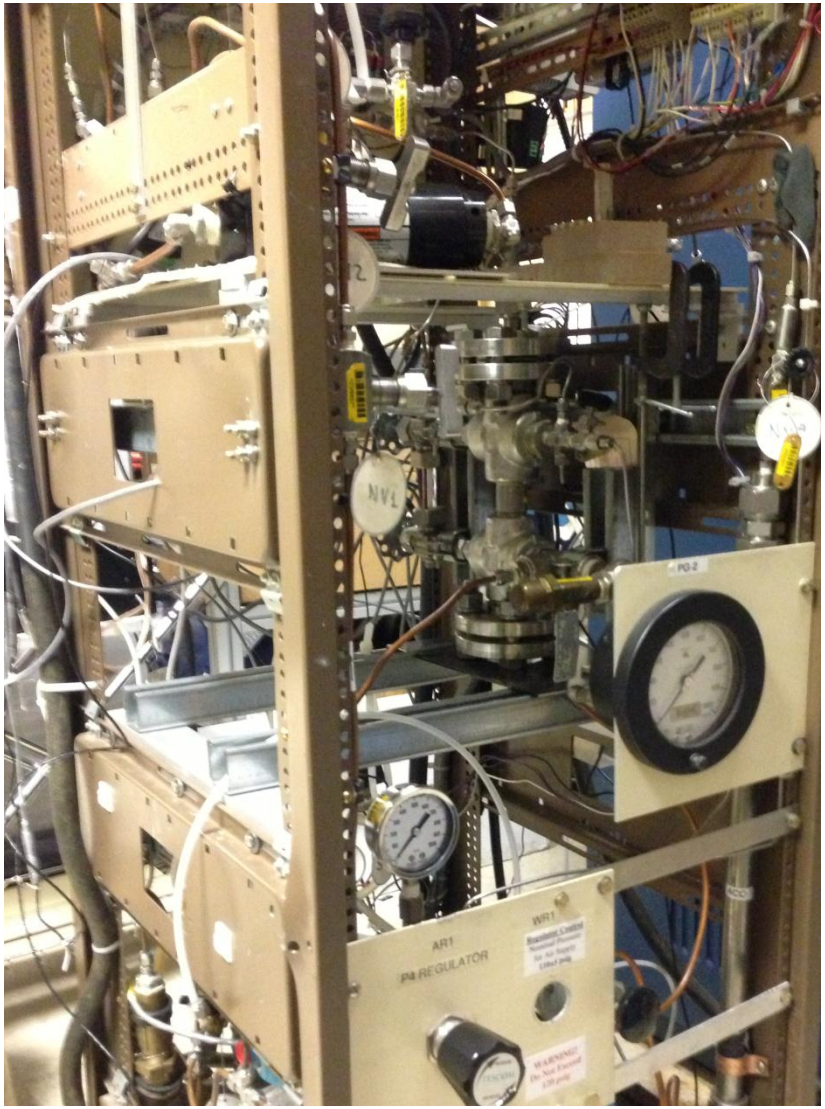
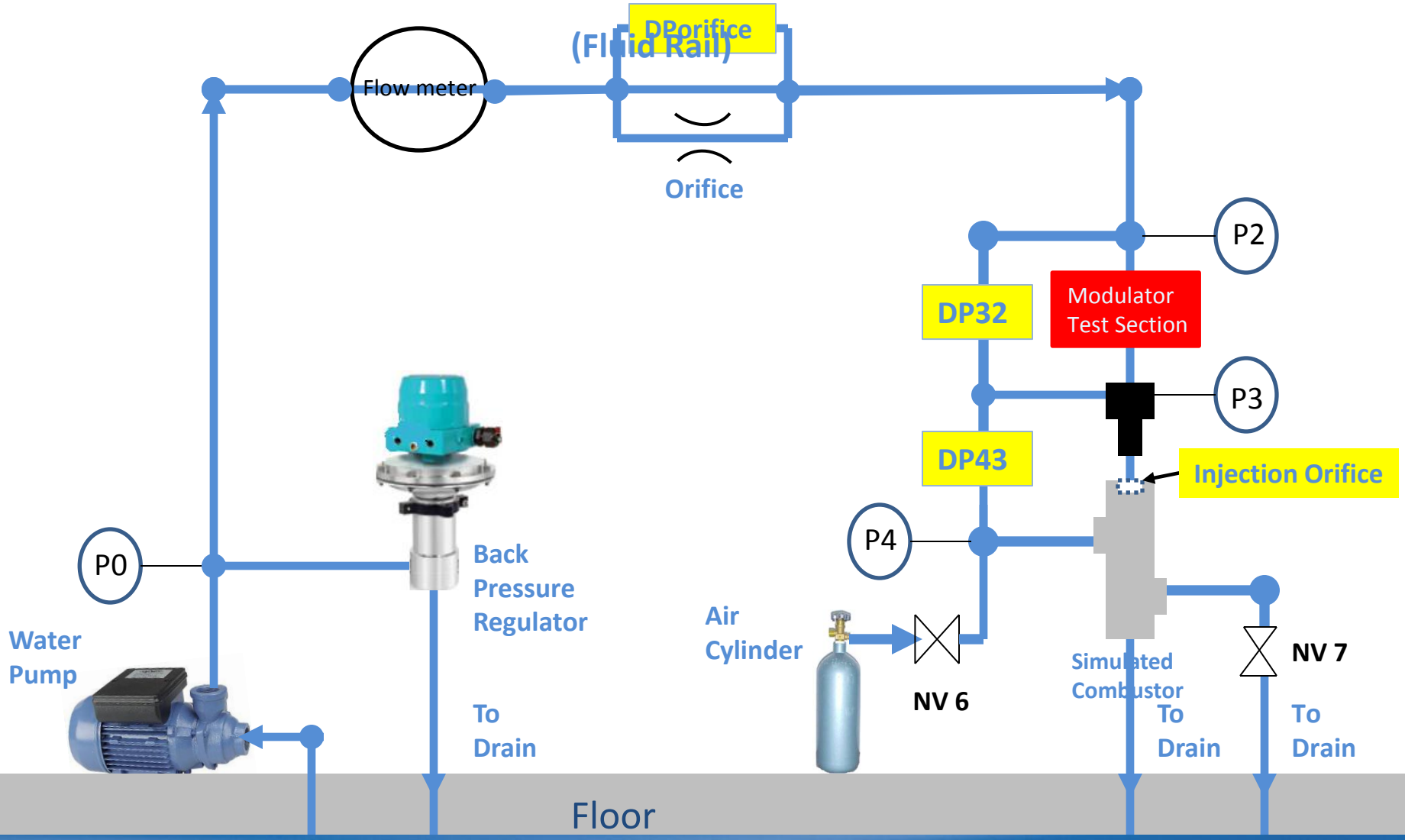
Ce7a Test Rig for High Frequency Modulator Experiments



Outline

- Ce7a test rig design concept
- Ce7a Data acquisition (DAQ) system
- Ce7a future upgrades
- Summary

Ce7a Test Rig (design concept):



Experiment Equations (flow calculations):

- $F_N = \frac{\dot{m}}{\sqrt{\Delta P}}$; $F_N \propto$ Orifice Hole Size
- $F_{N_{injection\ orifice}} = \frac{\dot{m}}{\sqrt{\Delta P_{injection\ orifice}}} = \frac{\dot{m}}{\sqrt{\Delta DP43}} = \frac{\dot{m}_{P2}}{P3 - P4}$
- $F_{N_{modulator}} = \frac{\dot{m}}{\sqrt{\Delta P_{modulator}}} = \frac{\dot{m}}{\sqrt{\Delta DP32}} = \frac{\dot{m}}{P2 - P3}$

DPorifice
Flow meter
DP32
DP43
Modulator Test Section
P2
P3
P4
Injection Orifice
Simulated Combustor
P0
Back Pressure Regulator
Water Pump
Air Cylinder
NV 6
NV 7
To Drain
To Drain
Floor

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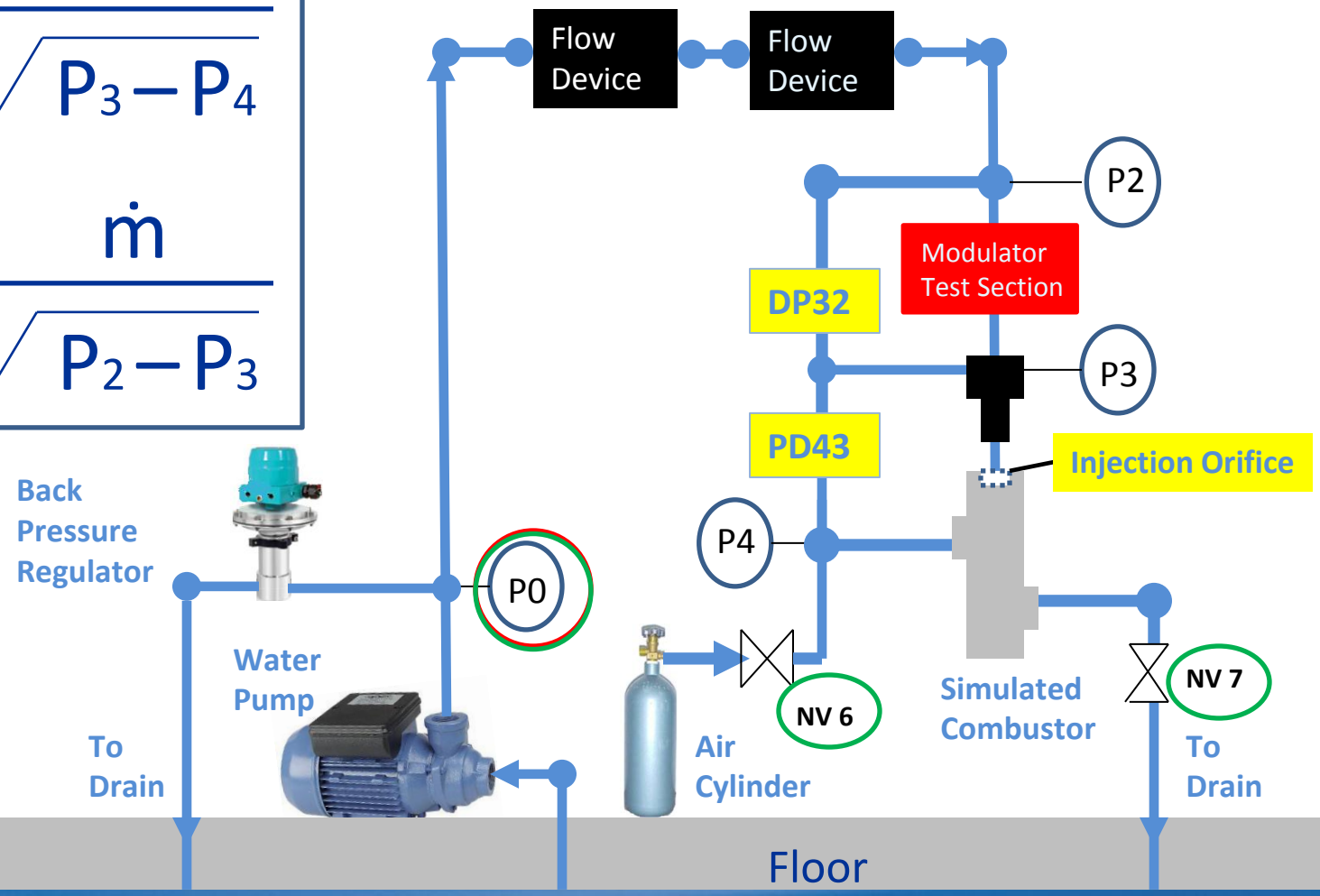
Experiment Pre-test Conditions (tuning process):

$$FN_{injection\ orifice} = \frac{\dot{m}}{\sqrt{P_3 - P_4}}$$

$$FN_{modulator} = \frac{\dot{m}}{\sqrt{P_2 - P_3}}$$



Host Computer:

- Standard computer
- Host Computer

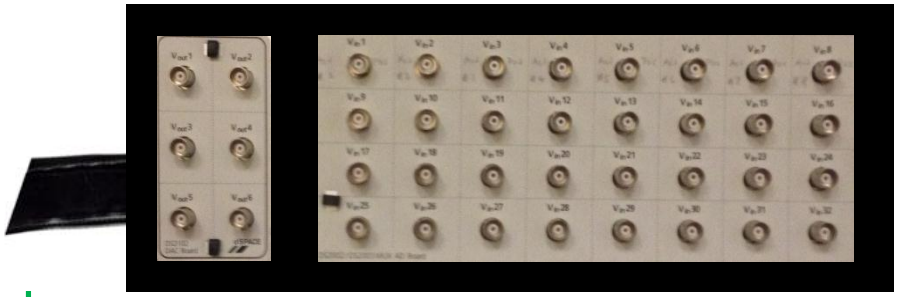
- Matlab and Simulink software

Data Acquisition (DAQ) System Components:

- dSPACE computer system
- dSPACE (ControlDesk) software
- PFI (Precision Filter, Inc) 28000 system
- PFI filter software

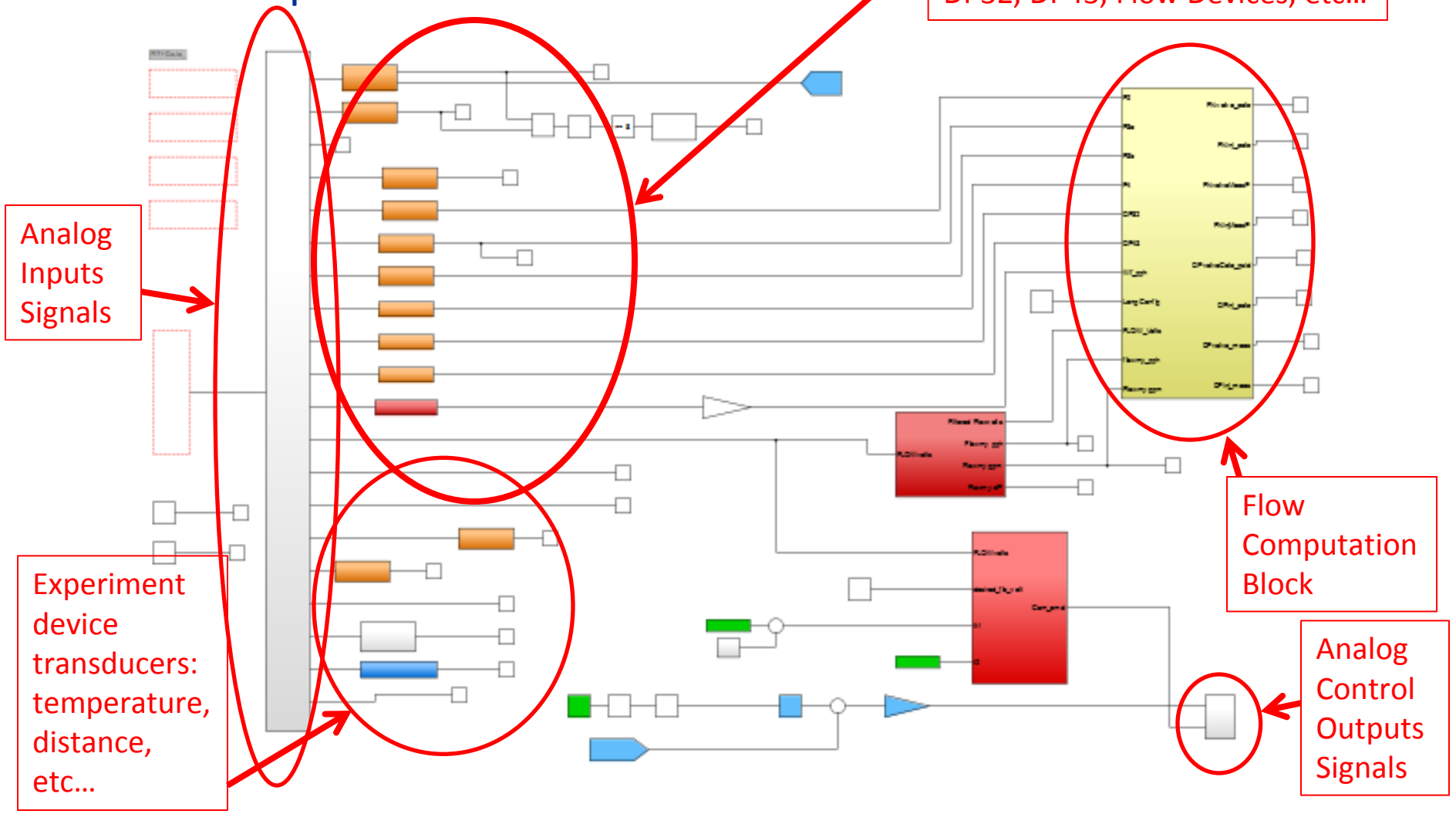
dSPACE System:

- Real-time operating system
- 32 Analog input channels (16 bit resolution)
- 6 Analog output channels (14 bit resolution)
- Programmable input and output voltage ranges (± 5 and 0-10 volts)
- Digitize analog high frequency response pressure and flow signals
- Perform control feedback processes (in real-time)



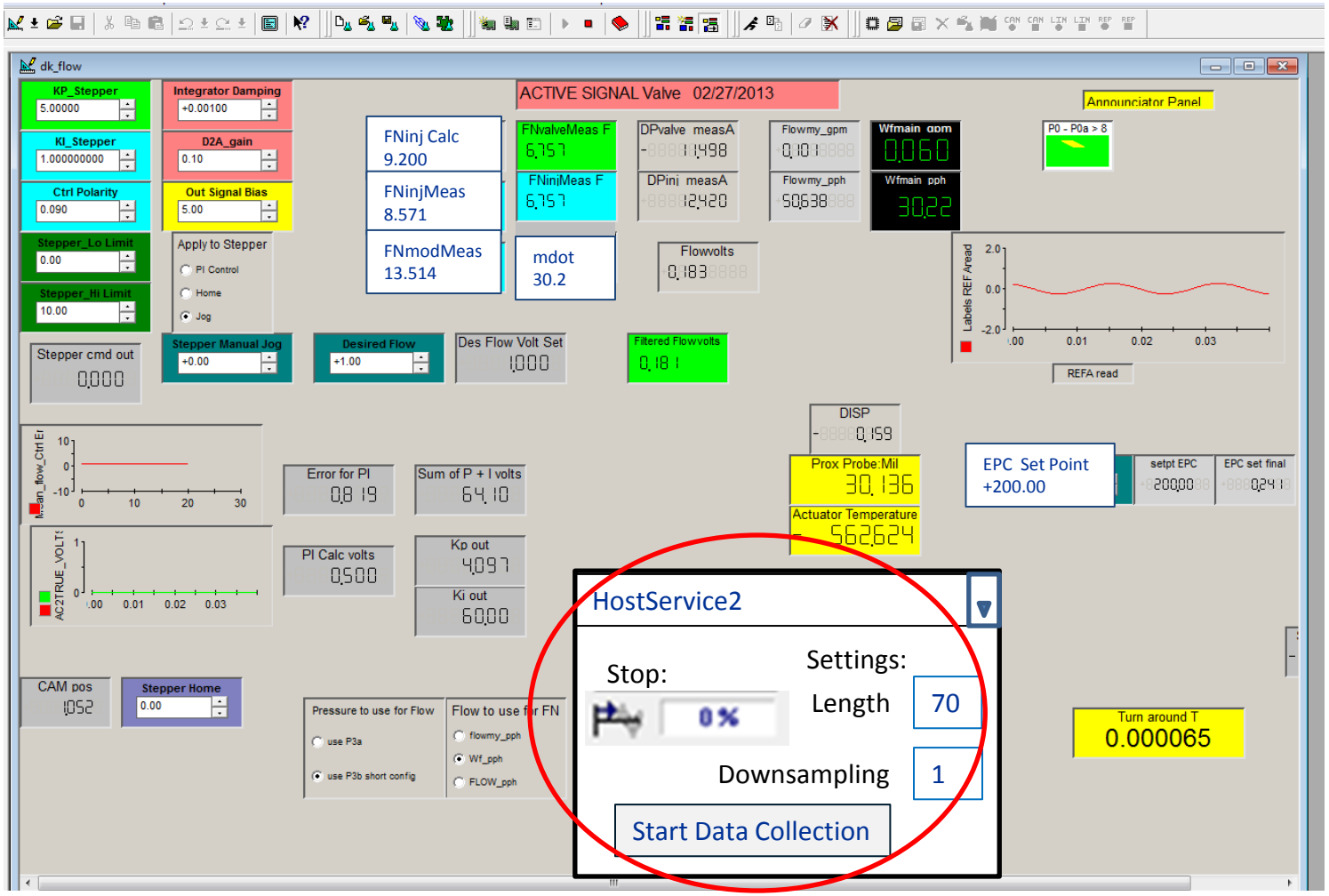
Experiment Model:

- Simulink model
- 5 KHz sample rate
- Modular layout



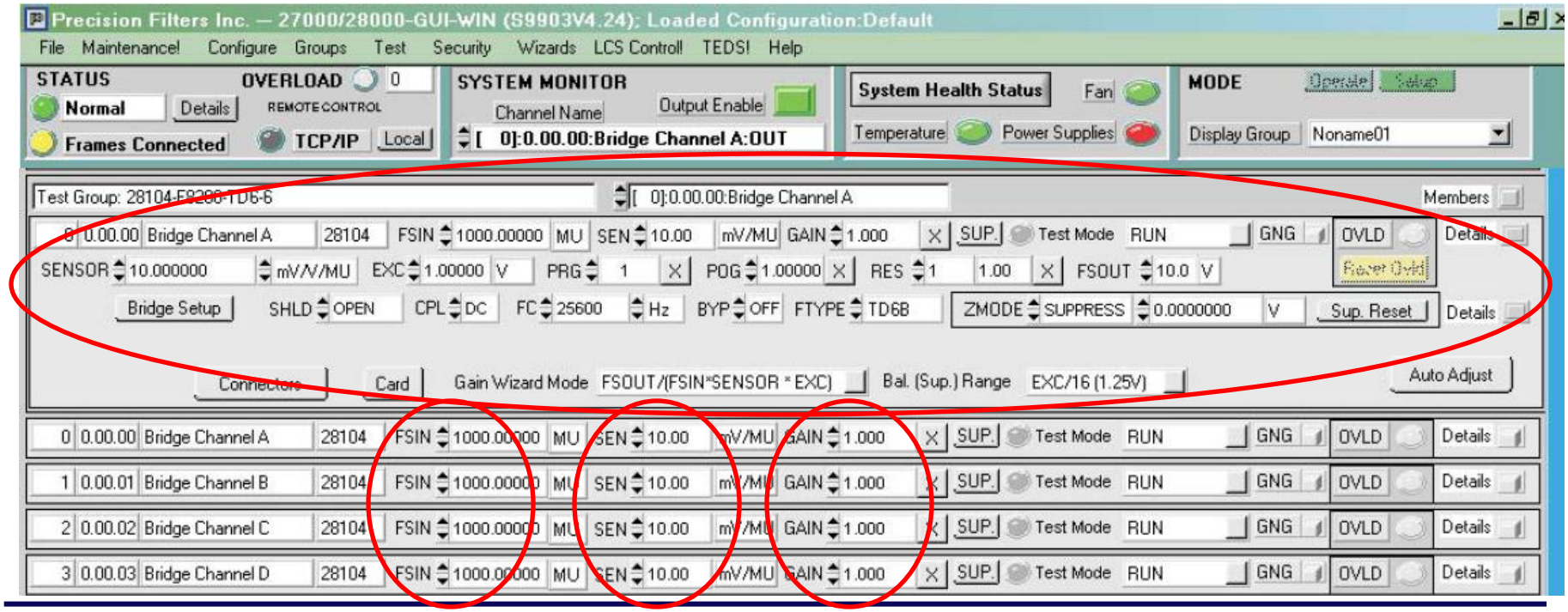
dSPACE Experiment GUI:

- ControlDesk software
- Data display(s)
- Data saving (50 Hz and 5K Hz)
- Real-time interaction with hardware
- Sample Rate 5 KHz

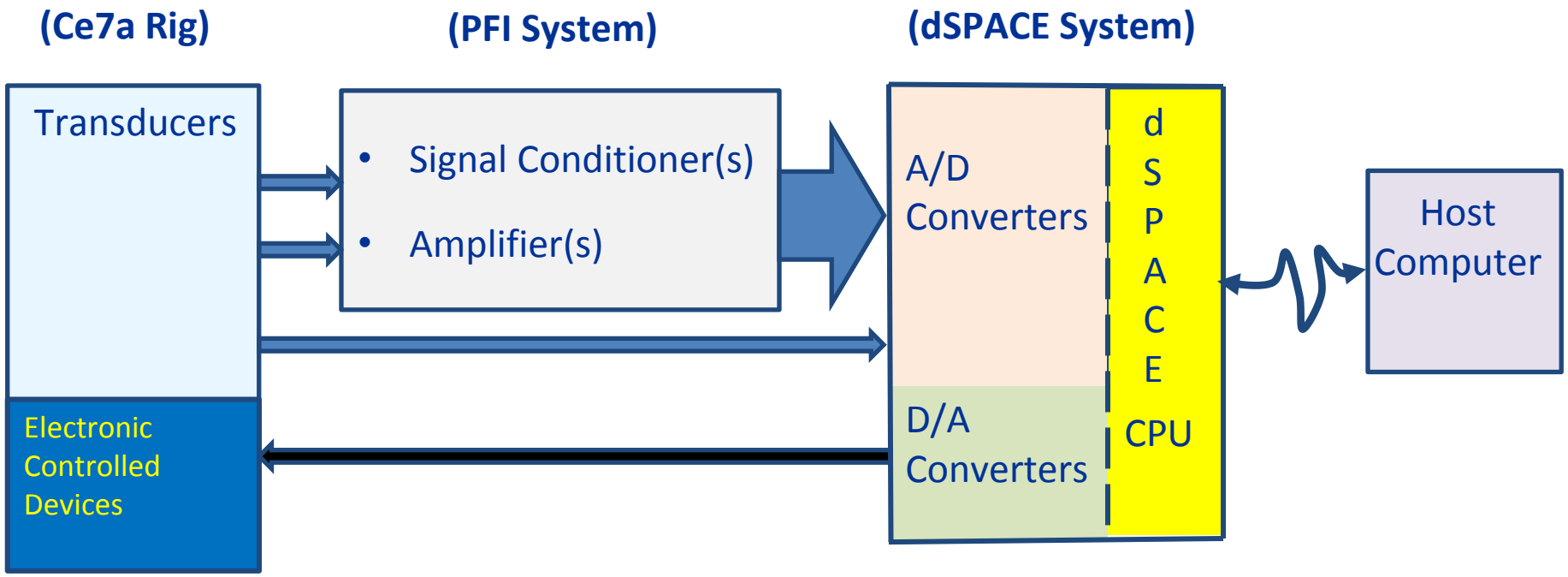


PFI 28000 System:

- Programmable analog channels
  (16 signal conditioners, 16 amplifiers)
- High performance filter(s): Butterworth,
  Bessel, High, Low, and Band pass filters
- Up to 200 kHz “filtered” bandwidth
- Graphical User Interface (GUI)



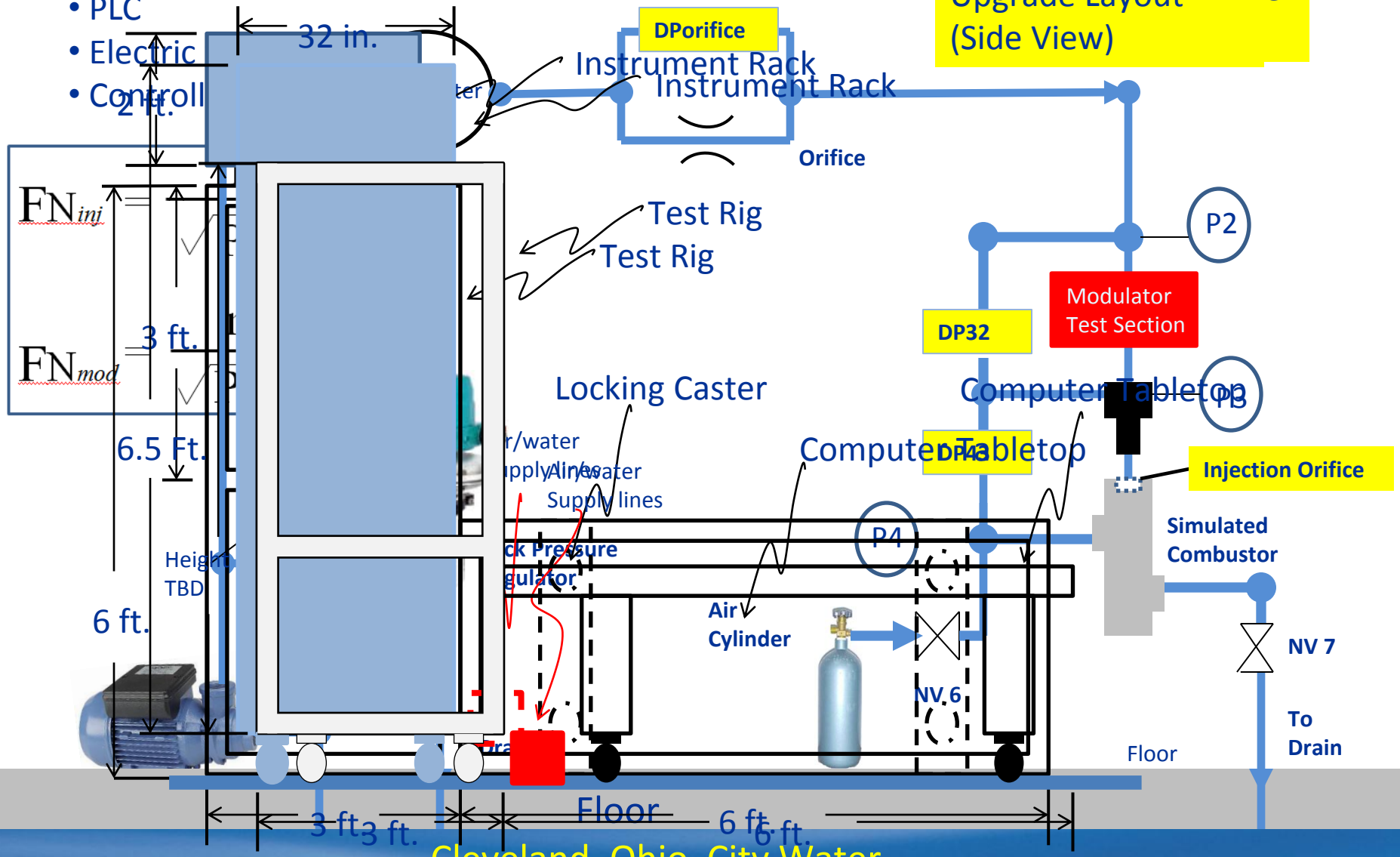
DAQ System Component Flow Diagram:




Test Rig
Instrumentation Rack
Support Electronics

Ce7a Facility Upgrades:

- Rebuild Ce7a test rig
- Automate Ce7a test experiment process
  - PLC
  - Electric
  - Controll



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Summary

- Ce7a test rig design concept:
  - To simulates a fuel delivery circuit for an aircraft combustion system
  - To assess the performance of a high frequency modulator device
- Data acquisition system capabilities:
  - Configured to condition high frequency response transducer for pressure and flow measurements
  - Perform real-time data acquisition processes (display and record experiment data)
  - Customize experiment processes for a modulator device
- Ce7a future upgrades:
  - Automate the experiment set up process
    - Reduce experiment set up time
    - Increase data reliability and repeatability
  - Rebuild test rig to expand its working space

QUESTIONS?